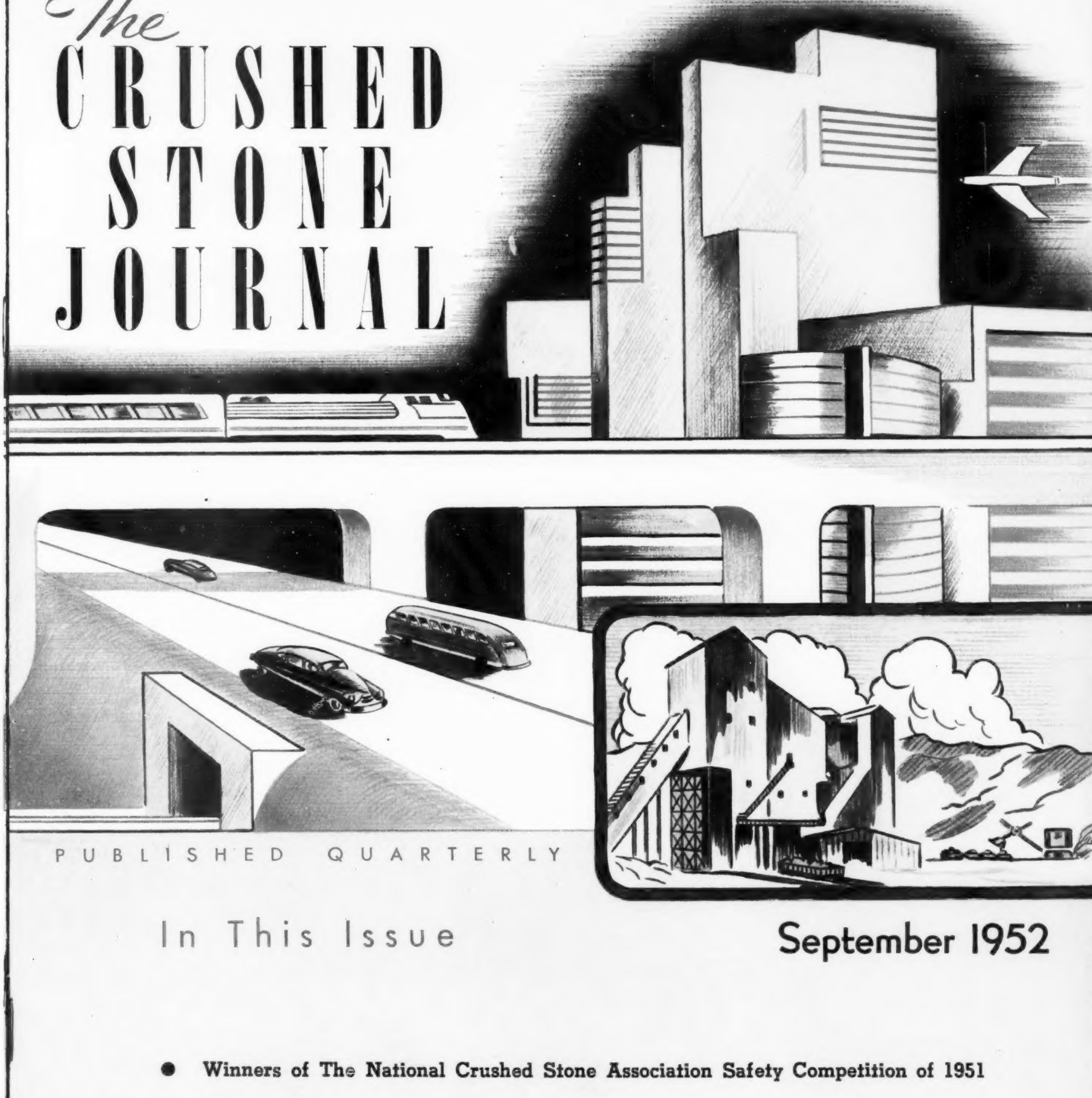
The CRUSHED STONE JOURNAL



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In This Issue

September 1952

- Winners of The National Crushed Stone Association Safety Competition of 1951
- Stone Screenings and Their Uses
- The Coming Fifth Short Course of the National Crushed Stone Association

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The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

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THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

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Winners of The National Crushed Stone Association Safety Competition of 1951

By **ELIZABETH K. ELSNER and C. A. BLUM**

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ACCORDING to the Bureau of Mines, United States Department of the Interior, the injury experience at crushed stone plants enrolled in the 1951 National Crushed Stone Association Safety Competition was one of the best in the 26-year history of the contest. The injury severity rate in 1951 of 2.515 days of lost time for each 1,000 man-hours of work was a 54 per cent reduction from the rate of 5.462 in 1926, the first year of the competition, and it was also the second lowest rate on record. The record rate of 1.093 was established in 1945. In 1951, the frequency rate of 19.182 injuries for each million man-hours of work was bettered in only 3 previous years, and it was the lowest rate since 1941. Except for a slight increase in the 1950 frequency rate, the frequency and severity rates have improved appreciably in each of the last five years; and this pattern attests to the cooperation of employees and supervisors in well-organized and efficient safety programs to reduce injury-producing hazards. The continuing improvement in the safety records of participating plants proves the value of competition.

The Winner

The Port Inland quarry of the Inland Lime and Stone Company at Gulliver, Schoolcraft County, Michigan, had the best safety record in the 1951 National Crushed Stone Association Safety Competition for having an operating time of 808,389 man-hours without a disabling injury. For this outstanding accomplishment in safety it won the symbolic bronze plaque, an award of recognition, provided by the Explosives Engineer Magazine. The award in 1951 was the fifth time the Port Inland quarry has had the best safety record of participating operations, having been previously so honored in 1933, 1934, 1938, and 1939. This quarry has been enrolled in the competition in each of the past 19 years, and during this period the frequency and severity of injuries have been well below the over-all experience of the industry. This outstanding safety record in 1951 and previous years is a commendable display of joint employee and employer action in observing safe work practices. The Association, in recognition of the plant's 1951 safety record, awards a suitable certificate to each individual who contributed to this performance.

The Bell underground limestone mine of the Warner Company, Bellefonte Division, at Bellefonte, Centre County, Pennsylvania, had the second best safety record in the 1951 contest. This plant was operated 327,395 man-hours without any lost-time injuries. Third place in the competition was the Security quarry of the North American Cement Corporation at Hagerstown, Washington County, Maryland. There were no disabling injuries at this plant during 172,061 man-hours of worktime.

Eight quarries and one underground mine had no lost-time injuries in 1951 and will receive Certificates of Honorable Mention from the National Crushed Stone Association. Including the trophy winner, the 10 injury-free operations were worked

TABLE I

RELATIVE STANDING OF QUARRIES IN THE 1951 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE INJURY-SEVERITY RATES OF THE QUARRIES[1]

Rank	Man-hours worked	Number of injuries[2]					Average days of disability per temp. injury	Number of days of disability[2]					Frequency rate[3]	Severity rate[3]
		F.	P.T.	P.P.	Temp.	Total		F.	P.T.	P.P.	Temp.	Total		
1	808,389	—	—	—	—	—	—	—	—	—	—	—	0.000	0.000
3	172,061	—	—	—	—	—	—	—	—	—	—	—	.000	.000
4	124,617	—	—	—	—	—	—	—	—	—	—	—	.000	.000
5	92,812	—	—	—	—	—	—	—	—	—	—	—	.000	.000
6	89,873	—	—	—	—	—	—	—	—	—	—	—	.000	.000
7	76,039	—	—	—	—	—	—	—	—	—	—	—	.000	.000
8	57,299	—	—	—	—	—	—	—	—	—	—	—	.000	.000
9	47,756	—	—	—	—	—	—	—	—	—	—	—	.000	.000
10	22,000	—	—	—	—	—	—	—	—	—	—	—	.000	.000
11	126,609	—	—	—	1	1	1	—	—	—	1	1	7.898	.008
12	502,243	—	—	—	2	2	13	—	—	—	25	25	3.982	.050
13	158,870	—	—	—	3	3	3	—	—	—	9	9	18.883	.057
14	81,200	—	—	—	1	1	5	—	—	—	5	5	12.315	.062
15	63,467	—	—	—	1	1	6	—	—	—	6	6	15.756	.095
16	85,496	—	—	—	2	2	6	—	—	—	11	11	23.393	.129
17	34,000	—	—	—	1	1	9	—	—	—	9	9	29.412	.265
18	61,053	—	—	—	1	1	17	—	—	—	17	17	16.379	.278
20	162,584	—	—	—	7	7	9	—	—	—	66	66	43.055	.406
21	98,910	—	—	—	1	1	43	—	—	—	43	43	10.110	.435
22	208,333	—	—	—	12	12	8	—	—	—	100	100	57.600	.480
23	112,330	—	—	—	8	8	7	—	—	—	55	55	71.219	.490
24	93,983	—	—	—	3	3	19	—	—	—	57	57	31.921	.606
25	380,442	—	—	1	12	13	14	—	—	75	164	239	34.171	.628
26	112,835	—	—	—	1	1	73	—	—	—	73	73	8.862	.647
27	159,852	—	—	—	6	6	19	—	—	—	113	113	37.535	.707
28	31,408	—	—	—	1	1	24	—	—	—	24	24	31.839	.764
29	326,024	—	—	1	1	2	6	—	—	250	6	256	6.135	.785
30	106,142	—	—	—	2	2	47	—	—	—	93	93	18.843	.876
33	29,822	—	—	—	3	3	12	—	—	—	37	37	100.597	1.241
34	156,075	—	—	—	8	8	25	—	—	—	197	197	51.257	1.262
35	45,869	—	—	—	1	1	65	—	—	—	65	65	21.801	1.417
36	226,254	—	—	—	5	5	127	—	—	—	637	637	22.099	2.815
38	51,520	—	—	—	7	7	50	—	—	—	353	353	135.870	6.852
40	330,239	—	—	1	10	11	22	—	—	3,000	215	3,215	33.309	9.735
41	113,927	—	—	1	—	1	—	—	—	3,000	—	3,000	8.778	26.333
42	90,971	1	—	—	—	1	—	6,000	—	—	—	6,000	10.993	65.955
Totals and rates 1951	5,441,304	1	—	4	100	105	24	6,000	—	6,325	2,381	14,706	19.297	2.703
1950	6,510,173	2	—	7	153	162	25	12,000	—	3,854	3,825	19,679	24.884	3.023

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

a total of 1,818,241 man-hours or slightly better than 27 per cent of the total work-time of all 42 enrolled plants.

The following plants, excluding the trophy winner, had no disabling injuries:

Bell mine, Warner Company, Bellefonte Division, Bellefonte, Centre County, Pennsylvania; 327,395 man-hours.

Security quarry, North American Cement Corporation, Hagerstown, Washington County, Maryland; 172,061 man-hours.

LeRoy quarry, The General Crushed Stone Company, LeRoy, Genessee County, New York; 124,617 man-hours.

Rock Hill quarry, The General Crushed Stone Company, Quakertown, Bucks County, Pennsylvania; 92,812 man-hours.

Auburn quarry, The General Crushed Stone Company, Auburn, Cayuga County, New York; 89,873 man-hours.

Jordanville quarry, The General Crushed Stone Company, Jordanville, Herkimer County, New York; 76,039 man-hours.

Middlefield No. 1 quarry, The New Haven Trap Rock Company, Middlefield, New Haven County, Connecticut; 57,299 man-hours.

Plainville No. 4 quarry, The New Haven Trap Rock Company, Plainville, Hartford County, Connecticut; 47,756 man-hours.

McCoy quarry, Warner Company, Bridgeport, Montgomery County, Pennsylvania; 22,000 man-hours.

Statistics of the Competition

The rates of frequency and severity of injuries at the 42 plants enrolled in the 1951 competition were lower than the respective averages for the 26 years of the competition. The frequency rate of 19.182 injuries per million man-hours was the fourth lowest annual rate, 36 per cent better than the 26-year average, and a 23-per cent improvement compared with the rate of the previous year. The severity rate of 2.515 days lost per thousand man-hours was the second best annual rate, 54 per cent lower than the 26-year average, and a 35-per cent improvement over the 1950 rate.

A total of 6,620,762 man-hours of worktime was accumulated by the participating plants in the 1951 competition. During this worktime, there were 127 lost-time injuries, the lowest number since 1941. Of this total, 1 was a fatality, 5 were permanent partials, and 121 were temporary total disabilities. The average disability of the temporary total injuries was 26 days or equal to the corresponding figure in 1950.

Thirty-six open quarries and six underground mines were enrolled in the 1951 competition. The frequency rate of open quarries was 19.297 per million man-hours and the severity rate 2.703 per thousand man-hours. The frequency rate, a 29-per cent improvement over the 1950 rate, was 35 per cent lower than the average rate for the 26 years of the contest. It also was the fourth best rate in the competition history.

The severity rate of 2.703 was also the fourth lowest in the same period. This rate was 12 per cent less than the 1950 rate and 49 per cent lower than the 26-year average.

At the 6 underground mines enrolled in the 1951 competition the frequency rate of 18.653 per million man-hours was a 24-per cent improvement compared with the preceding year, 42 per cent lower than the average for the 26 years, and the seventh best rate in the history of the competition. The severity rate in 1951 of 1.647 days per thousand man-hours of worktime was 81 per cent lower than the 1950 rate and 78-per cent improvement over the 26-year average.

Operations in 14 states enrolled in the 1951 competition. New York and Pennsylvania had 10 each, Virginia 6, Connecticut 3, Maryland, Texas, and West Virginia, 2 each, and California, Illinois, Kentucky, Michigan, Oklahoma, Ohio, and Tennessee 1 each.

TABLE II

RELATIVE STANDING OF UNDERGROUND MINES IN THE 1951 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE INJURY-SEVERITY RATES OF THE MINES[1]

Rank	Man-hours worked	Number of injuries[2] F.	P.T.	P.P.	Temp.	Total	Average days of disability per temp. injury	Number of days of disability[2] F.	P.T.	P.P.	Temp.	Total	Frequency rate[3]	Severity rate[3]
2	327,395	—	—	—	—	—	—	—	—	—	—	—	0.000	0.000
19	108,930	—	—	—	10	10	4	—	—	—	42	42	91.802	.386
31	157,418	—	—	—	4	4	39	—	—	—	155	155	25.410	.985
32	432,116	—	—	—	5	5	97	—	—	—	483	483	11.571	1.118
37	33,600	—	—	—	2	2	69	—	—	—	138	138	59.524	4.107
39	119,999	—	—	1	—	1	—	—	—	1,125	—	1,125	8.333	9.375
Totals and rates 1951	1,179,458	—	—	1	21	22	39	—	—	1,125	818	1,943	18.653	1.647
1950	1,102,273	1	—	1	25	27	32	6,000	—	3,000	810	9,810	24.495	8.900

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which tnis table relates are not revealed

[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability

[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE III

YEARLY SUMMARY—QUARRIES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-51[1]

Year	Flants	Man-hours worked	Number of injuries [2]					Number of days of disability [2]					Frequency rate [3]	Severity rate [3]
			Fatal	P. T.	P. P.	Temp.	Total	Fatal	P. T.	P. P.	Temp.	Total		
1926	40	5,298,983	3	—	6	207	216	18,000	—	9,000	4,239	31,239	40.763	5.895
1927	48	7,876,791	9	—	2	458	469	54,000	—	2,100	7,186	63,286	59.542	8.034
1928	53	7,509,098	8	—	4	322	334	48,000	—	8,700	5,493	62,193	44.479	8.282
1929	53	7,970,325	4	—	5	286	295	24,000	—	5,760	5,533	35,293	37.012	4.428
1930	68	8,013,415	6	—	9	227	242	36,000	—	7,250	3,671	46,921	30.199	5.855
1931	58	5,085,857	4	—	13	198	215	24,000	—	18,660	3,540	46,200	42.274	9.084
1932	40	2,661,850	1	—	4	75	80	6,000	—	6,750	2,481	15,231	30.054	5.722
1933	40	2,704,871	1	—	1	67	69	6,000	—	48	2,893	8,941	25.510	3.306
1934	46	3,288,257	1	—	2	106	109	6,000	—	2,850	1,873	10,723	33.148	3.261
1935	46	4,166,306	2	1	8	77	88	12,000	6,000	9,900	3,015	30,915	21.122	7.420
1936	50	6,399,023	5	—	14	182	201	30,000	—	8,168	4,590	42,758	31.411	6.682
1937	47	6,199,001	7	—	9	136	152	42,000	—	5,875	4,461	52,336	24.520	8.443
1938	47	4,658,119	2	—	6	76	84	12,000	—	6,600	3,184	21,784	18.033	4.677
1939	44	4,219,086	2	—	2	51	55	12,000	—	4,800	1,678	18,478	13.036	4.380
1940	46	4,358,409	1	—	5	78	84	6,000	—	2,550	3,013	11,563	19.273	2.653
1941	47	5,777,587	3	—	5	98	106	18,000	—	9,300	2,266	29,566	18.347	5.117
1942	48	7,178,935	3	2	1	183	189	18,000	12,000	1,500	4,239	35,739	26.327	4.978
1943	34	4,750,314	4	—	5	134	143	24,000	—	7,146	3,862	35,008	30.103	7.370
1944	32	3,996,433	3	—	4	118	125	18,000	—	3,000	3,323	24,323	31.278	6.086
1945	46	6,087,037	—	—	1	135	136	—	—	750	3,505	4,255	22.343	0.699
1946	46	7,292,175	1	—	6	197	204	6,000	—	5,141	4,130	15,271	27.975	2.094
1947	42	6,971,790	5	—	5	197	207	30,000	—	6,900	4,990	41,890	29.691	6.008
1948	47	6,953,569	4	—	11	181	196	24,000	—	8,018	4,642	36,660	28.187	5.272
1949	57	7,166,644	3	—	11	153	167	18,000	—	9,465	3,345	30,810	23.302	4.299
1950	45	6,510,173	2	—	7	153	162	12,000	—	3,854	3,825	19,679	24.884	3.023
1951	36	5,441,304	1	—	4	100	105	6,000	—	6,325	2,381	14,706	19.297	2.703
Total	—	148,535,352	85	3	150	4,195	4,433	510,000	18,000	160,410	97,358	785,768	29.845	5.290

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE IV

YEARLY SUMMARY—UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-1951[1]

Year	Flants	Man-hours worked	Number of injuries [2]					Number of days of disability [2]					Frequency rate [3]	Severity rate [3]
			Fatal	P. T.	P. P.	Temp	Total	Fatal	P. T.	P. P.	Temp.	Total		
1926	3	517,926	—	—	—	34	34	—	—	—	533	533	65.646	1.029
1927	2	318,449	1	—	1	14	16	6,000	—	300	68	6,368	50.244	19.997
1928	5	542,193	1	—	1	68	70	6,000	—	300	888	7,188	129.105	13.257
1929	4	665,520	1	—	1	30	32	6,000	—	300	617	6,917	48.083	10.393
1930	6	595,367	1	—	1	15	17	6,000	—	225	468	6,693	28.554	11.242
1931	3	345,105	—	—	—	4	4	—	—	—	147	147	11.591	.426
1932	2	158,450	—	—	—	6	6	—	—	—	165	165	37.867	1.041
1933	3	229,381	—	—	—	11	11	—	—	—	349	349	47.955	1.521
1934	4	248,146	—	—	—	13	13	—	—	—	287	287	52.389	1.157
1935	2	175,994	—	—	—	3	3	—	—	—	249	249	17.046	1.415
1936	4	334,747	1	—	—	7	8	6,000	—	—	117	6,117	23.899	18.274
1937	3	364,680	—	—	—	3	3	—	—	—	91	91	8.226	.250
1938	3	334,442	—	—	—	2	2	—	—	—	133	133	5.980	.398
1939	4	393,039	—	—	1	7	8	—	—	600	457	1,057	20.354	2.689
1940	4	375,987	—	—	1	8	9	—	—	4,500	888	5,388	23.937	14.330
1941	4	591,568	—	—	1	15	16	—	—	750	169	919	27.047	1.553
1942	4	785,894	—	—	1	33	34	—	—	1,800	1,213	3,013	43.263	3.834
1943	5	1,019,771	—	—	3	45	48	—	—	4,950	1,123	6,073	47.069	5.955
1944	4	727,496	1	—	1	27	29	6,000	—	2,400	796	9,196	39.863	12.641
1945	7	1,238,845	—	—	2	22	24	—	—	3,000	755	3,755	19.373	3.031
1946	8	1,338,563	2	—	2	31	35	12,000	—	675	1,045	13,720	26.147	10.250
1947	8	1,291,162	5	—	1	29	35	30,000	—	75	1,588	31,663	27.107	24.523
1948	4	940,031	—	—	—	16	16	—	—	—	935	935	17.021	.995
1949	5	981,692	—	—	1	17	18	—	—	900	467	1,367	18.336	1.392
1950	6	1,102,273	1	—	1	25	27	6,000	—	3,000	810	9,810	24.495	8.900
1951	6	1,179,458	—	—	1	21	22	—	—	1,125	818	1,943	18.653	1.647
Total	—	16,796,179	14	—	20	506	540	84,000	—	24,900	15,176	124,076	32.150	7.387

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE V

YEARLY SUMMARY—QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-51[1]

Year	Plants	Man-hours worked	Number of injuries[2] Fatal	P. T.	P. P	Temp.	Total	Number of days of disability[2] Fatal	P. T.	P. P.	Temp.	Total	Frequency rate[3]	Severity rate[3]
1926	43	5,816,909	3	—	6	241	250	18,000	—	9,000	4,772	31,772	42.978	5.462
1927	50	8,195,240	10	—	3	472	485	60,000	—	2,400	7,254	69,654	59.181	8.499
1928	58	8,051,291	9	—	5	390	404	54,000	—	9,000	6,381	69,381	50.178	8.617
1929	57	8,635,845	5	—	6	316	327	30,000	—	6,060	6,150	42,210	37.865	4.888
1930	74	8,608,782	7	—	10	242	259	42,000	—	7,475	4,139	53,614	30.086	6.228
1931	61	5,430,962	4	—	13	202	219	24,000	—	18,660	3,687	46,347	40.324	8.534
1932	42	2,820,300	1	—	4	81	86	6,000	—	6,750	2,646	15,396	30.493	5.459
1933	43	2,934,252	1	—	1	78	80	6,000	—	48	3,242	9,290	27.264	3.166
1934	50	3,536,403	1	—	2	119	122	6,000	—	2,850	2,160	11,010	34.498	3.113
1935	48	4,342,300	2	1	8	80	91	12,000	6,000	9,900	3,264	31,164	20.957	7.177
1936	54	6,733,770	6	—	14	189	209	36,000	—	8,168	4,707	48,875	31.038	7.258
1937	50	6,563,681	7	—	9	139	155	42,000	—	5,875	4,552	52,427	23.615	7.987
1938	50	4,992,561	2	—	6	78	86	12,000	—	6,600	3,317	21,917	17.226	4.390
1939	48	4,612,125	2	—	3	58	63	12,000	—	5,400	2,135	19,535	13.660	4.236
1940	50	4,734,396	1	—	6	86	93	6,000	—	7,050	3,901	16,951	19.643	3.580
1941	51	6,369,155	3	—	6	113	122	18,000	—	10,050	2,435	30,485	19.155	4.786
1942	52	7,964,829	3	2	2	216	223	18,000	12,000	3,300	5,452	38,752	27.998	4.865
1943	39	5,770,085	4	—	8	179	191	24,000	—	12,096	4,985	41,081	33.102	7.120
1944	36	4,723,929	4	—	5	145	154	24,000	—	5,400	4,119	33,519	32.600	7.096
1945	53	7,325,882	—	—	3	157	160	—	—	3,750	4,260	8,010	21.840	1.093
1946	54	8,630,738	3	—	8	228	239	18,000	—	5,816	5,175	28,991	27.692	3.359
1947	50	8,262,952	10	—	6	226	242	60,000	—	6,975	6,578	73,553	29.287	8.902
1948	51	7,893,600	4	—	11	197	212	24,000	—	8,018	5,577	37,595	26.857	4.763
1949	62	8,148,336	3	—	12	170	185	18,000	—	10,365	3,812	32,177	22.704	3.949
1950	51	7,612,446	3	—	8	178	189	18,000	—	6,854	4,635	29,489	24.828	3.874
1951	42	6,620,762	1	—	5	121	127	6,000	—	7,450	3,199	16,649	19.182	2.515
Total	—	165,331,531	99	3	170	4,701	4,973	594,000	18,000	185,310	112,534	909,844	30.079	5.503

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed

[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability

[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE VI

NUMBER OF INJURIES, BY CLASSIFICATIONS, AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1951

Classification	Fatal	Permanent Total	Permanent Partial	Temporary	Total
Falls and slides of rock or materials	—	—	1	13	14
Handling materials or objects	—	—	1	24	25
Hand tools	—	—	—	7	7
Explosives	—	—	—	1	1
Haulage	—	—	1	4	5
Falls of persons	—	—	—	20	20
Bumping against objects	—	—	—	3	3
Falling objects	—	—	—	11	11
Flying objects or particles	—	—	—	7	7
Electricity	—	—	—	—	—
Drilling	—	—	—	2	2
Machinery	—	—	2	12	14
Stepping on objects	—	—	—	3	3
Burns	—	—	—	—	—
Other causes	1	—	—	5	6
Total	1	—	5	112	118
Not stated	—	—	—	9	9
Grand total	1	—	5	121	127

TABLE VII

DAYS OF DISABILITY, BY CLASSIFICATIONS, OF INJURIES AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1951

Classification	Fatal	Permanent Total	Permanent Partial	Temporary	Total
Falls and slides of rock or materials	—	—	3,000	306	3,306
Handling materials or objects	—	—	75	428	503
Hand tools	—	—	—	60	60
Explosives	—	—	—	19	19
Haulage	—	—	1,125	90	1,215
Falls of persons	—	—	—	1,049	1,049
Bumping against objects	—	—	—	86	86
Falling objects	—	—	—	212	212
Flying objects or particles	—	—	—	81	81
Electricity	—	—	—	—	—
Drilling	—	—	—	52	52
Machinery	—	—	3,250	199	3,449
Stepping on objects	—	—	—	64	64
Burns	—	—	—	—	—
Other causes	6,000	—	—	62	6,062
Total	6,000	—	7,450	2,708	16,158
Not stated	—	—	—	491	491
Grand Total	6,000	—	7,450	3,199	16,649

TABLE VIII

NUMBER AND PERCENTAGE DISTRIBUTION OF INJURIES AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1949-51, BY CLASSIFICATIONS

Classification	1949 Number	1949 Per cent of total	1950 Number	1950 Per cent of total	1951 Number	1951 Per cent of total	Total Number	Total Per cent of total
Falls and slides of rock	16	9.0	19	10.6	14	11.9	49	10.3
Handling materials	10	5.6	25	13.9	25	21.2	60	12.6
Hand tools	18	10.1	10	5.6	7	5.9	35	7.3
Explosives	4	2.2	1	.6	1	.9	6	1.3
Haulage	25	14.1	23	12.8	5	4.2	53	11.1
Falls of persons	31	17.4	26	14.4	20	17.0	77	16.2
Bumping against objects	3	1.7	5	2.8	3	2.5	11	2.3
Falling objects	22	12.4	13	7.2	11	9.3	46	9.7
Flying objects	18	10.1	11	6.1	7	5.9	36	7.6
Electricity	—	—	8	4.4	—	—	8	1.7
Drilling	3	1.7	6	3.3	2	1.7	11	2.3
Machinery	17	9.6	16	8.9	14	11.9	47	9.9
Stepping on objects	2	1.1	9	5.0	3	2.5	14	2.9
Burns	4	2.2	4	2.2	—	—	8	1.7
Other causes	5	2.8	4	2.2	6	5.1	15	3.1
Total	178	100.0	180	100.0	118	100.0	476	100.0
Cause not stated	7	—	9	—	9	—	25	—
Grand total	185	—	189	—	127	—	501	—

Classification of Accidents

Injuries received by personnel at the enrolled plants while handling materials or objects predominated in 1951 with 21 per cent of the total. Falls of persons accounted for 17 per cent, machinery accidents and falls and slides of rock or materials each injured approximately 12 per cent of the total, and 10 per cent were injured by falling objects. These five types of accidents accounted for 84 of the 118 injuries with stated causes. The most severe injuries were the result of accidents charged to machinery, falls and slides of rock or materials, haulage, and falls of persons in the order named. Under these four categories, 56 per cent of the total time lost through disabling injuries occurred. The only fatality during 1951 was at a quarry and resulted from failure of an employee working in a dust bin to use a safety device which had been provided by the company—he was suffocated when material within the bin covered him.

TABLE IX

NUMBER OF AND PERCENTAGE DISTRIBUTION OF DAYS OF DISABILITY FROM INJURIES AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1949-51, BY CLASSIFICATIONS

Classification	1949 Days of disability	1949 Per cent of total	1950 Days of disability	1950 Per cent of total	1951 Days of disability	1951 Per cent of total	Total Days of disability	Total Per cent of total
Falls and slides of rock	6,674	21.06	6,600	22.48	3,306	20.5	16,580	21.5
Handling materials	304	.96	759	2.59	503	3.1	1,566	2.0
Hand tools	290	.91	222	.76	60	.4	572	.7
Explosives	6,061	19.12	17	.06	19	.1	6,097	7.9
Haulage	8,315	26.23	3,762	12.81	1,215	7.5	13,292	17.2
Falls of persons	1,320	4.17	1,006	3.43	1,049	6.5	3,375	4.4
Bumping against objects	32	.10	21	.07	86	.5	139	.2
Falling objects	610	1.93	6,147	20.94	212	1.3	6,969	9.0
Flying objects	1,021	3.22	476	1.62	81	.5	1,578	2.1
Electricity	—	—	6,114	20.82	—	—	6,114	7.9
Drilling	3,380	10.66	112	.38	52	.3	3,544	4.6
Machinery	3,591	11.33	3,903	13.29	3,449	21.4	10,943	14.2
Stepping on objects	14	.04	32	.11	64	.4	110	.1
Burns	67	.21	34	.11	—	—	101	.1
Other causes	20	.06	156	.53	6,062	37.5	6,238	8.1
Total	31,699	100.00	29,361	100.00	16,158	100.0	77,218	100.0
Cause not stated	478	—	128	—	491	—	1,097	—
Grand total	32,177	—	29,489	—	16,649	—	78,315	—

The Competition

The annual competition for the promotion of safety in the crushed stone industry is conducted by the Bureau of Mines under the same rules as the National Safety Competition and the same records are used in both contests. There are two additional qualifications for the crushed stone competition which are that the operation must have commercial production of crushed stone and that the company be a member of the Association.

TABLE X

EMPLOYMENT AND INJURY DATA FOR CRUSHED STONE PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1950 AND 1951, COVERING IDENTICAL PLANTS FOR BOTH YEARS AND PLANTS ENROLLED ONLY IN 1950 OR IN 1951[1]

	No.	Man-hours worked	Number of injuries[2]					Days of disability[2]					Frequency rate[3]	Severity rate[3]
			F.	P.T.	P.P.	Temp.	Total	F.	P.T.	P.P.	Temp.	Total		
Plants enrolled in 1950 only.......	15	2,240,824	1	—	3	75	79	6,000	—	2,850	1,852	10,702	35.255	4.776
Identical plants enrolled both years, 1950...........	36	5,371,622	2	—	5	103	110	12,000	—	4,004	2,783	18,787	20.478	3.497
Identical plants enrolled both years, 1951...........	36	6,011,655	1	—	5	101	107	6,000	—	7,450	2,719	16,169	17.799	2.690
Plants enrolled in 1951 only.......	6	609,107	—	—	—	20	20	—	—	—	480	480	32.835	0.788

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed

[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability

[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE XI

AVERAGE DAYS OF DISABILITY PER TEMPORARY INJURY AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION

Year	Underground mines			Open quarries			Total		
	Number of temporary injuries	Number of days of disability	Average days of disability	Number of temporary injuries	Number of days of disability	Average days of disability	Number of temporary injuries	Number of days of disability	Average days of disability
1926.....................	34	533	16	207	4,239	20	241	4,772	20
1927.....................	14	68	5	458	7,186	16	472	7,254	15
1928.....................	68	888	13	322	5,493	17	390	6,381	16
1929.....................	30	617	21	286	5,533	19	316	6,150	19
1930.....................	15	468	31	227	3,671	16	242	4,139	17
1931.....................	4	147	37	198	3,540	18	202	3,687	18
1932.....................	6	165	28	75	2,481	33	81	2,646	33
1933.....................	11	349	32	67	2,893	43	78	3,242	42
1934.....................	13	287	22	106	1,873	18	119	2,160	18
1935.....................	3	249	83	77	3,015	39	80	3,264	41
1936.....................	7	117	17	182	4,590	25	189	4,707	25
1937.....................	3	91	30	136	4,461	33	139	4,552	33
1938.....................	2	133	67	76	3,184	42	78	3,317	43
1939.....................	7	457	65	51	1,678	33	58	2,135	37
1940.....................	8	888	111	78	3,013	39	86	3,901	45
1941.....................	15	169	11	98	2,266	23	113	2,435	22
1942.....................	33	1,213	37	183	4,239	23	216	5,452	25
1943.....................	45	1,123	25	134	3,862	29	179	4,985	28
1944.....................	27	796	29	118	3,323	28	145	4,119	28
1945.....................	22	755	34	135	3,505	26	157	4,260	27
1946.....................	31	1,045	34	197	4,130	21	228	5,175	23
1947.....................	29	1,588	55	197	4,990	25	226	6,578	29
1948.....................	16	935	58	181	4,642	26	197	5,577	28
1949.....................	17	467	27	153	3,345	22	170	3,812	22
1950.....................	25	810	32	153	3,825	25	178	4,635	26
1951.....................	21	818	39	100	2,381	24	121	3,199	26
Total..............	506	15,176	30	4,195	97,358	23	4,701	112,534	24

Stone Screenings and Their Uses

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BY stone screenings is meant the product of a stone crushing and screening plant, passing through a small screen, generally 3/8 in. or 1/2 in. square opening, and containing all of the dust of fracture. The Simplified Practice Recommendation, R 163-48,[1] gives the following required gradation for stone screenings:

Sieve Size	Total Passing, per cent
3/8 in.	100
No. 4	85–100
No. 100	10–30

Different state highway departments have different size requirements for screenings as well as for other sizes of stone, but the above gradation is offered as one which is desirable.

Physical Characteristics of Stone Screenings

The physical characteristics of stone screenings depend to a large extent on those of the parent rock. If the rock is hard and tough, the screenings will be highly resistant to crushing. Soft rock, on the other hand, will produce screenings which will crush and grind more easily than those produced by the harder rock; but the soft rock screenings possess other properties which make them highly desirable for use in highway construction. Thus, limestone screenings are particularly noted for their excellent cementing value. The fine dust seems to have high binding properties and not only do these properties add to the stability of the crushed stone pavement by virtue of their effect on stabilization of the screenings mortar surrounding the coarser rock, but also they render the layer of stone waterproof against percolating water. It must not be inferred, however, that the harder rocks possess little cementing value, for that is not so. High cementing value may be obtained even from quartzite screenings if there is a large amount of minus 200 mesh dust present.

One very important characteristic of stone screenings is their particle shape. Screenings in general are quite angular in shape and it is this very property which imparts to the screenings a high degree of stability, irrespective of whether they will cement together or not. By stability is meant the resistance of the layer of material to indentation or change in shape under loads. Angular screenings interlock, one particle with another, and thus high internal friction is imparted to the mass and also it is almost impossible for one particle to rotate with respect to its neighbor. Because of this effect, when a vertical load, such as a wheel load, is applied to a layer of screenings, that load is not carried directly to that portion of the subgrade immediately under the load, but, on the other hand, is given a wide spread, and thus a screenings layer possesses a concentrated load-carrying capacity far beyond what might reasonably be expected.

Screenings for Use as a Blanket Course

(a) Under Macadam or Railroad Ballast

Not too many years ago, it was common practice to build macadam roads and macadam bases, by depositing the coarse, more or less one-sized stone, containing large voids, directly on the subgrade. This layer was given a preliminary rolling before filling with screenings as the binding material, but when the subgrade was composed of plastic clay or other soft material, it was not uncommon to find that the subgrade had extruded upward through the voids and thus, the lower layer of stone became lubricated and its stability was very seriously impaired.

It was not uncommon to find railroad ballast which, in the old days, was generally of large size, 3/4 to 2 1/2 in., deposited directly on the subgrade and, under the action of the vertical loads imposed by railroad traffic, and likewise due to vibration effects, mud soon worked its way up through these voids. Such ballast was hard to maintain in a stable condition, and today when, for some purpose trenches are dug under track built in this manner, it is not uncommon to find the stone ballast as deep as 4 or 5 ft. below the level of the present subgrade.

[1] U. S. Department of Commerce, sold by the Superintendent of Documents, Washington, D. C.

The ineffectiveness of this old type construction no doubt is rather generally recognized at the present time, and to overcome this objectionable intrusion of the subgrade into the voids of the stone, the expedient of using a blanket layer of fine material under the stone layer is now generally practiced.

A layer of stone screenings is ideal for this purpose. In the first place, its gradation is such that it produces very fine voids, into which the clay cannot penetrate and the screenings thereby serve as a blanket layer to prevent the upward intrusion of the clay into the large voids in the stone. The entire thickness of the coarse stone layer, whether it be macadam or railroad ballast, is thus maintained as a fully efficient layer for spreading the load to the underlying subgrade, so that the pressure on the soft subgrade is maintained at a value sufficiently low to prevent undue deformation when the load is applied. The screenings layer itself has practically the same stability as the stone layer which it supports and the thickness of the screenings can be included with the thickness of the stone layer in determining the effective thickness of the pavement which supports the load.

(*b*) *Under Concrete Pavements*

Formerly it was the practice to lay concrete pavements directly on the subgrade irrespective of whether the material in the subgrade was of a plastic nature or was composed of a more granular type. Perhaps engineers were misled many years ago by the theory of concrete pavement design which told them that the thickness of a concrete pavement need not be altered very much because of differences in the softness of the subgrade. The theory was correct but, of late years, heavy wheel loads have caused rather large deflections in concrete pavements, with the result that the subgrade which had become softened because of the presence of excessive water, was washed out through the permeable expansion joints and cracks, and also at the shoulders. Thus, in a relatively short time, under the passage of many heavy wheel loads, a void was left under the pavement, which then became improperly supported and excessive cracking and permanent deflection of the slabs resulted. This phenomenon is now known as mud pumping, and it is a common phenomenon where there is a large amount of heavy traffic and the pavement is laid on particular kinds of subgrades which are susceptible to the washing action of the water in the undersurface void space, with the passage of each truck.

The Ohio State Highway Department has made an extensive study of mud pumping and this study is published in their Research Bulletin No. 2, entitled "A Survey of Pumping in Ohio." Among others, they have come to the following conclusions as they pertain to sub-base material:

1. A subgrade soil, even under the most severe intensities of heavy loadings recorded in Ohio, will not pump if
   a. The sand and gravel content (material retained on the No. 200 sieve) is in excess of 55 per cent, the soil is fairly well graded, and
   b. The plasticity index is 6 or less.
2. Granular sub-bases constructed of materials meeting the requirements of (1) above will prevent pumping under traffic conditions of a severity equal to that under which natural subgrades of similar materials will prevent pumping.

The sub-bases studied varied from 4 to 24 in. in design thickness. A 12 in. thickness was used most frequently. All sub-bases constructed of materials meeting the requirements of (1) above prevented pumping under widely varying conditions of subgrade soil, traffic, and pavement design. This strongly suggests that some sub-bases were thicker than necessary to prevent pumping.

Stone screenings will meet the above requirements, and because of their extreme stability, it seems reasonable to believe that a lesser thickness will be required than will be necessary with less stable material. With an extremely stable layer of screenings under a concrete pavement, there is practically no chance for the particles to be removed by rush of water from under the pavement, and thus the premise of a uniformly elastic support upon which the theory of concrete pavement design is based will be sufficiently maintained, and the pavement will be preserved intact over many more years than would be the case were it to be laid on an undesirable type of subgrade.

Screenings for Macadam Base Construction

In the construction of macadam bases, it is desirable that the entire volume of voids in the base be filled with screenings and, furthermore, it is desirable that these screenings contain from 10 to 30 per cent of dust passing the No. 100 sieve, because it is this fine material which serves as the binding medium. It is impossible to force large particles of

stone down through relatively small voids in a macadam layer, as is sometimes attempted, and it is strongly advocated that the Division of Simplified Practice Gradation for Screenings be used, because the maximum size is small enough to readily penetrate the voids in macadam. Attention is called to the newer machines[2] which have been developed of late years employing vibration as a means for making the screenings readily penetrate into the macadam. It is said that screenings will penetrate as much as 12 in. of macadam laid in a single layer when these newer vibration schemes are used. It is the dust which serves as the cementing medium in screenings, and consequently, it is important that enough dust be present, for the coarser particles have practically no cementing value.

Screenings Used as a Base Course

As before pointed out, a screenings layer, when built of the proper kind of screenings, will have very high stability when used as the base course under a proper kind of wearing surface.

In the park system in New York City the use of screenings as a base course has involved various types of construction. For illustration, a large expanse of tennis courts has been built with 3 or 4 in. of screenings base, upon which a sheet asphalt or a rock asphalt course has been laid without a binder course. These tennis courts are used for roller skating and also, in the winter, they are flooded and used for ice skating. Also, screenings have been used as the base course under bituminous concrete for the building of emergency pavements where quickly built and sufficiently stable construction became necessary.

Screenings have been employed in parking lots of wide expanse, in some cases laid over swampy ground, and such surfaces have behaved in a remarkably stable manner.

The shoulders on the northern end of the New Jersey Turnpike were covered with screenings. The shoulder material in this case was rather fine clean sand, which possessed very little resistance to indentation. After the screenings were laid the shoulders were rendered very stable indeed and, even after a heavy rain, no indentation was left by automobile wheels. It was also noticeable that no gullies formed in the screenings covered shoulders due to wash, whereas on the outside of the screenings layer deep gullies were formed in the supporting sandy material, due to water action.

The approximate gradation of the screenings used in the New York City area is as follows:

Sieve Size	Total Passing, per cent
1/2 in.	100
No. 20	20-40
No. 200	5-15

Use of Stone Screenings as Fine Aggregate in Concrete

There is no doubt that a lot of good concrete has been built with the use of stone screenings as a fine aggregate, but it is not advocated that unprocessed stone screenings be used in this way. Screenings resulting from secondary crushers, when properly screened to size and properly cleaned of excessive dust, may be used very successfully as the fine aggregate in concrete, but let it be emphasized that such fine aggregate must be prepared carefully to a proper gradation so that it will be uniform at all times. Raw screenings, unprepared, are apt to have far too much dust and far too much coarse material. The dust is apt to ball up and cause pitting of the concrete under the action of the weather. Excessive coarse material will, naturally, make for lack of workability. It is our opinion that the following gradation for stone sand will be suitable for use as an all-purpose fine aggregate:

Sieve Size	Total Passing, per cent	Range
No. 4	100	100
No. 8	95	95-100
No. 16	70	60-75
No. 30	45	35-50
No. 50	20	15-25
No. 100	8	5-10
No. 200	5	3-6

Fineness Modulus 2.62

Particle shape in stone sand is important and the more cubical the sand can be made, the more workable will be the concrete.[3]

Stone Screenings for Use in Bituminous Concrete Wearing Surfaces

The question sometimes arises, Can stone screenings be used successfully, as such, in bituminous concrete wearing surfaces? It is my opinion that stone screenings can thus be used and made into a very suitable bituminous concrete mix, but this does

[2] Write to Macadam Pavements, Inc., Columbus, Ohio

[3] See the *Crushed Stone Journal*, June 1951

not imply that the screenings can be used just as they come from the stock pile with no attention whatever paid to gradation. Screenings do not always have the same gradation, and if this is so, one cannot obtain uniformity in the concrete mix without special precautions. However, if the screenings are separated and properly recombined, and careful attention is paid to the control of the entire plant, excellent bituminous concrete for wearing surfaces can be, and is being, produced. But I emphasize the necessity for careful control. The following gradation of screenings should give excellent results when used in a bituminous concrete wearing surface:

Sieve Size	Total Passing, Permissible Range, per cent
1/2 in.	100
No. 4	50-70
No. 10	30-50
No. 40	10-20
No. 200	3-8

It should go without saying that the above ranges of gradation should not be allowed in any one day's run. There should be a further limitation to the effect that the grading of the aggregate in any one day's run shall be of such uniformity that the percentages of material passing the Nos. 4, 10, and 200 sieves for any one sample shall not vary from the average for all samples for the run by more than the following tolerances:

Sieve Size	Material Passing, per cent
No. 4	±5
No. 10	±5
No. 200	±2

As in the case with other materials, stone screenings must be used intelligently. When so used, excellent results can be obtained.

These are the important uses for screenings, but there are many more. Thus, screenings will make excellent sidewalks, they may be used as abrasives in the treatment of icy pavements. Thousands of concrete block have been made with stone screenings and, when properly cured and then brought to the proper degree of dryness, they have given excellent results. No doubt still other uses will occur to stone producers.

Federal Aid to Highways Increased to 575 Million Annually

THE annual level of federal aid to highways has been raised to $575 million, according to provisions in the Federal-Aid Highway Act of 1952, recently enacted by Congress. This is $75 million more than the current authorization under the 1950 act. Funds in the new law are authorized for the fiscal years ending June 30, 1954 and 1955.

For the first time in the history of federal-aid legislation, funds are earmarked for development of the National System of Interstate Highways, a 38,000-mile network of the country's most important roads. Special authorization of $25 million annually is provided for that system, to be matched by the states under the traditional 50-50 federal-aid formula.

Safety Funds Doubled

Congress doubled the funds with which the Commissioner of Public Roads "is authorized and directed to assist in carrying out the action program of the President's Highway Safety Conference and to cooperate with the state highway departments and other agencies in this program to advance the cause of safety on the streets and highways." The new act authorizes $150,000 annually for this purpose. The 1950 act had provided $75,000 a year.

Federal-aid authorizations in the new act include $247.5 million annually for projects on the federal-aid primary highway system; $165 million for secondary roads, and $137.5 million for the primary highway system in urban areas.

Grace Period Granted

These sums apportioned to the states are to be available for two years after the close of the fiscal year for which they were authorized. Similar provision was made in the 1950 act, so that last of the funds from the current $500 million annual authorization will be available to the states until June 30, 1955.

Latest available statistical data show that the balance of current federal-aid funds still unprogrammed, and therefore still available under the 1950 act, was $283,606,000 as of May 31. On that same date, projects totaling 39,393 miles at a total cost of $2,473,908,000 were either programmed, at the approved-plan stage, or actually under construction.—*Review and Outlook, Automotive Safety Foundation.*

The Coming Fifth Short Course of the National Crushed Stone Association

Those who have attended the previous short courses given by the National Crushed Stone Association will be interested to know that plans for the Fifth Short Course are now practically complete. We have a list of very fine speakers selected from various Federal, State, and other organizations because of their special familiarity with their subjects. They are national and, in some cases, international authorities.

As usual, the course this year will be given at the U. S. Chamber of Commerce, Washington, D. C. The dates selected are January 7, 8, and 9, 1953. Judging by preliminary estimates, we expect an attendance of well over 100 representatives from the various crushed stone company members of the Association.

Also, we hope the States and Federal Government will not hesitate to send any of their interested engineers. We are glad to have them present, not only as listeners, but likewise as participants in the discussions. The talks will be informal and will not be recorded.

PRELIMINARY PROGRAM FOR FIFTH SHORT COURSE

Wednesday, January 7, 1953

Morning

9:00—Registration

10:00—Welcome—A. T. Goldbeck

10:10—Laboratory Tests of Stone, Portland Cement Concrete, and Bituminous Concrete—J. M. Rice

11:10—Discussion

11:20—Intermission

11:25—The Size of Aggregates
(a) Sieves (b) Mechanical Analysis (c) Methods of Tabulating and Plotting Mechanical Analyses—J. E. Gray

12:00—Discussion

12:10—Adjournment

Afternoon

2:00—Specific Gravity, Solid Volume and Voids—J. M. Rice

2:30—Discussion

2:40—Stone Sand as a Fine Aggregate in Concrete—A. T. Goldbeck

3:15—Discussion

3:25—Intermission

3:30—Flat and Elongated Pieces
(a) How Measured (b) Effect in Concrete
(c) Effect in Bituminous Concrete and in Other Pavement Types—J. E. Gray

4:15—Discussion

4:25—(a) Weight of Asphaltic Concrete Per Square Yard Per Inch
(b) Weight of Stone and Screenings Required for Water Bound Macadam—J. M. Rice

4:50—Discussion

5:00—Adjournment

Thursday, January 8, 1953

Morning

9:00—The Flexible Pavement—How to Determine Its Required Thickness—A. T. Goldbeck

9:50—Discussion

10:00—The New Jersey Turnpike—Its Design, Construction, and Present Condition—George H. Dent

10:50—Discussion

11:05—Recess

11:10—The Plant Control of Bituminous Concrete—Donald D. Dagler

11:50—Discussion

12:00—Adjournment

Afternoon

2:00—What Temperature Ranges Are Suitable for Asphalt
(a) During Transportation
(b) During Mixing
—J. Y. Welborn

2:45—Discussion

3:00—The Problem of Shrinkage of Concrete Block—Carl A. Menzel

3:40—Discussion

3:50—Intermission

4:00—The Corps of Engineers Requirements for Bituminous Concrete for Use in Airports—Walter C. Ricketts

4:40—Discussion

5:00—Adjournment

Evening

6:30—Get-Together Party

FRIDAY, JANUARY 9, 1953

Morning

9:00—The Problem of Harmful Aggregates in Concrete
- (a) Deleterious Substances and Their Detection
- (b) Chemical Reactivity
- (c) Harmful vs. Non-harmful Chert —BRYANT MATHER

10:00—Discussion

10:30—Recess

10:35—Portland Cement—Its Manufacture, Its Chemical Compounds and Their Effects on Concrete—DR. R. H. BOGUE

11:15—Discussion

11:25—The Slipperiness of Concrete and Asphaltic Concrete Pavements—Its Measurement and Suggested Methods for Its Prevention—TILTON E. SHELBURNE

12:00—Discussion

12:10—Adjournment

Afternoon

2:00—The Construction of a Graded Stone Highway Base Course (Illustrated by motion pictures and slides)—CHARLES E. PROUDLEY

3:00—Discussion

3:15—Recess

3:20—Concrete Pavement Design
- (a) The Subgrade—HAROLD ALLEN
- (b) How to Determine Desirable Length, Width and Thickness of Slabs—E. A. FINNEY
- (c) Reinforcing Steel—Its Function and Design—F. B. BROWN
- (d) What Are the Trends in Concrete Pavement Design—L. M. ARMS

4:40—Discussion

4:50—Some Random Observations—A. T. GOLDBECK

5:05—Adjournment

SATURDAY, JANUARY 10, 1953

Laboratory Demonstrations

9:00-12:00 A. M.

There will be no formal laboratory demonstrations, but those wishing to see particular tests are cordially invited to the **National Crushed Stone Association Laboratory at 1415 Elliot Place, N. W. (just off the 4500 block of MacArthur Boulevard)** on Saturday morning. The laboratory will be open from 9:00 a. m. until noon and the following tests will be shown:

TESTS FOR STONE
- Deval Abrasion
- Los Angeles Abrasion
- Dorry Hardness
- Page Impact
- Specific Gravity

CONCRETE TESTS
- Mixing Concrete
- Slump
- Compression
- Measurement of Entrained Air
- Freezing and Thawing
- Dynamic Modulus

BITUMINOUS CONCRETE
- Immersion-Compression
- Circular Track
- Stripping Tests

Program Speakers

HAROLD ALLEN, *Principal Highway Engineer,*
Physical Research Branch,
Bureau of Public Roads,
Washington, D. C.

L. M. ARMS, *Manager,*
Highways and Municipal Bureaus,
Portland Cement Association,
Chicago, Ill.

DR. R. H. BOGUE, *Director,*
Portland Cement Association Fellowship,
National Bureau of Standards,
Washington, D. C.

F. B. BROWN, *Managing Director,*
Wire Reinforcement Institute, Inc.,
Washington, D. C.

DONALD D. DAGLER, *Head Research Engineer,*
Department of Highways,
Commonwealth of Pennsylvania,
Harrisburg, Pa.

GEORGE H. DENT, *Division Engineer,*
The Asphalt Institute,
Washington, D. C.

E. A. FINNEY, *Research Engineer,*
Highway Research Laboratory,
East Lansing, Mich.

A. T. GOLDBECK, *Engineering Director,*
National Crushed Stone Association,
Washington, D. C.

J. E. GRAY, *Field Engineer,*
National Crushed Stone Association,
Washington, D. C.

BRYANT MATHER, *Chief,*
Special Investigations Branch,
Concrete Research Division,
Waterways Experiment Station,
Jackson, Miss.

CARL A. MENZEL, *Manager,*
Housing and Cement Products Bureau,
Portland Cement Association,
Chicago, Ill.

CHARLES E. PROUDLEY, *Chief Materials Engineer,*
North Carolina State Highway and Public Works Commission,
Raleigh, N. C.

J. M. RICE, *Research and Testing Engineer,*
National Crushed Stone Association,
Washington, D. C.

WALTER C. RICKETTS, *Chief of Runways Section,*
Airfields Branch,
Office of the Chief of Engineers,
Gravelly Point, Va.

TILTON E. SHELBURNE, *Director of Research,*
Division of Research,
State Council of Highway Investigation and Research,
Charlottesville, Va.

J. Y. WELBORN, *Materials Engineer,*
Bituminous Section,
Bureau of Public Roads,
Washington, D. C.

Manufacturers Division—National Crushed Stone Association

These associate members are morally and financially aiding the Association in its efforts to protect and advance the interests of the crushed stone industry. Please give them favorable consideration whenever possible.

Allis-Chalmers Mfg. Co.
Milwaukee 1, Wis.
Crushing, Screening, Washing, Grinding, Cement Machinery; Motors; Texrope Drives; Centrifugal Pumps; Tractors

American Cyanamid Co.
Explosives Department
2527 Oliver Bldg., Pittsburgh 22, Pa.
Explosives and Blasting Supplies

American Manganese Steel Division American Brake Shoe Co.
109 North Wabash Ave., Chicago 2, Ill.
Manganese Steel Castings, Power Shovel Dippers, Material Handling Pumps, Heat and Corrosion Resistant Castings, Reclamation and Hard-Facing Welding Materials

American Pulverizer Co.
1249 Macklind Ave., St. Louis 10, Mo.
Manufacturers of Ring Crushers and Hammermills for Primary and Secondary Crushing

American Steel & Wire Div.
Rockefeller Bldg., 614 Superior Ave., N. W., Cleveland 13, Ohio
Wire Rope, Aerial Wire Rope Tramways, Electrical Wires and Cables, Welded Wire Fabric, Concrete Reinforcing, Wire Nails, Fencing, Netting

Atlas Powder Co.
Wilmington 99, Del.
Industrial Explosives and Blasting Supplies

Austin-Western Co.
601 N. Farnsworth Ave., Aurora 1, Ill.
Jaw and Roll Crushers, Conveyors, Feeders, Screens, and Bins—Separately or Combined in Complete Crushing, Screening and Washing Plants; All Types of Dump, Hopper, and Quarry Cars, Air and Electrically Operated, in Narrow and Standard Gauges; Power Shovels, Drag Lines, and Cranes; Road Making, Earth Handling, and Street Cleaning Equipment

Bacon-Greene & Milroy
205 Church St., New Haven 10, Conn.
"FARREL-BACON" Jaw Crushers for Primary and Secondary Operations, Conveyors, Elevators, Rolls, Screens

Bacon-Pietsch Co., Inc.
149 Broadway, New York 6, N. Y.
Manufacturers of Farrel-Bacon Crushers and Allied Screening and Conveying Equipment

Baldwin-Lima-Hamilton Corp. Construction Equipment Division
South Main St., Lima, Ohio
Power Shovels, Draglines and Cranes

Barber-Greene Co.
631 West Park Ave., Aurora, Ill.
Portable and Permanent Belt Conveyors, Belt Conveyor Idlers, Bucket Loaders both Wheel and Crawler Mounted, Asphalt Mixers and Finishers, Coal Handling Machines

Buchanan, C. G., Crushing Machinery Division of the Birdsboro Steel Foundry and Machine Co.
1941 Furnace St., Birdsboro, Pa.
Primary, Secondary, and Finishing Crushers and Rolls

Bucyrus-Erie Co.
South Milwaukee, Wis.
Excavating, Drilling and Material Handling Equipment

Buda Co.
154th St. and Commercial Ave., Harvey, Ill.
Diesel and Gasoline Engines; Material Handling Equipment; Lifting Jacks; Earth Drills and Maintenance of Way Equipment

Caterpillar Tractor Co.
Peoria 8, Ill.
Track-Type Tractors, Bulldozers, Earthmoving Scrapers, Motor Graders, Heavy-Duty Off-Road Hauling Units, Diesel Engines, and Diesel Electric Generating Sets

Chain Belt Co.
P. O. Box 2022, Milwaukee 1, Wis.
Rex Conveyors, Elevators, Feeders, Idlers; Drive and Conveyor Chains, Power Transmission Equipment; Concrete Mixers, Pavers, Pumpcrete and Portable Pumps

Construction Equipment
205 East 42nd St., New York 17, N. Y.
"The Equipment Application Magazine"

Continental Gin Co.
4500 Fifth Ave., S., Birmingham 2, Ala.
Conveyors—Belt, Screw, Flight, and Underground Mine; Elevators—Bucket and Screw; Feeders—Apron, Belt, Reciprocating, Table, and Screw; Drives—V-Belts, Chains and Sprockets, Gears and Speed Reducers

Cross Engineering Co.
P. O. Box 16, Carbondale, Pa.
Screen Plates and Sections, Perforated Plate for Vibrating, Rotary and Shaking Screens

Manufacturers Division—National Crushed Stone Association
(continued)

Cummins Engine Co., Inc.
Fifth and Union Sts., Columbus, Ind.
Lightweight Highspeed Diesel Engines (50-550 Hp.) for: On-Highway Trucks, Off-Highway Trucks, Buses, Tractors, Earthmovers, Shovels, Cranes, Industrial and Switcher Locomotives, Air Compressors, Logging Yarders and Loaders, Oil Well Drilling Rigs, Centrifugal Pumps, Generator Sets and Power Units, Work Boats and Pleasure Craft

Deister Machine Co.
1933 East Wayne St., Fort Wayne 4, Ind.
Deister Plat-O Vibrating Screen, Deister Compound Funnel Classifier

Detroit Diesel Engine Division General Motors Corp.
13400 West Outer Drive, Detroit 28, Mich.
Light Weight, Compact 2 Cycle Diesel Engines and "Package Power" Units for All Classes of Service

Diamond Iron Works, Inc.
1728 N. Second St., Minneapolis 11, Minn.
Jaw and Roll Crushers; Vibrator, Revolving, and Scrubber Screens; Drag Washers; Bucket Elevators; Belt Conveyors; Bins; Apron and Plate Feeders; Portable Gravel and Rock Crushing, Screening, and Washing Plants; Stationary Crushing, Screening, and Washing Plants; Hammermills

Du Pont, E. I., de Nemours & Co., Inc.
Wilmington 98, Del.
Explosives and Blasting Accessories

Eagle Iron Works
129 Holcomb Ave., Des Moines 13, Iowa
Fine Material Screw Washers—Classifiers—Dehydrators; Coarse Material Screw and Log Washers—Dewaterers; Water Scalping and Fine Material Settling Tanks; and "Swintek" Screen Chain Cutter Dredging Ladders

Easton Car & Construction Co.
Easton, Pa.
Off-Highway Transportation: Dump Trailers, Truck Bodies, and Cars for Mines, Quarries, and Earth Moving Projects

Ensign-Bickford Co.
Simsbury, Conn.
Primacord-Bickford Detonating Fuse and Safety Fuse

Euclid Road Machinery Co.
1361 Chardon Road, Cleveland 17, Ohio
Heavy-Duty Trucks and Dump Trailers for "Off-Highway" Hauls, Loaders for Earth Excavation

Even Spread Co.
P. O. Box 98, Owensville, Ohio
Power Spreaders and Attachments for Agricultural Lime and Fertilizer

Frog, Switch & Mfg. Co.
Carlisle, Pa.
Manganese Steel Department—Manufacturers of "Indian Brand" Manganese Steel Castings for Frogs, Switches, and Crossings, Jaw and Gyratory Crushers, Cement Mills, Mining Machinery, Etc., Steam Shovel Parts

General Electric Co.
1 River Road, Schenectady 5, N. Y.
Electric Motors, Controls, Locomotives, Coordinated Electric Drives for: Shovels, Drag Lines, Conveyors, Hoists, Cranes, Crushers, Screens, Etc.; Coordinated Power Generating and Distributing Systems Including Turbine Generators, Switchgear, Transformers, Cable, Cable Skids, Load Center Substations

Gill Rock Drill Co.
Lebanon, Pa.
Well Drill Tools and Supplies

Goodrich, B. F., Co.
500 South Main St., Akron 18, Ohio
Industrial Rubber Products — Flexible Bonded Edge Conveyor and Elevator Belting, Cord Conveyor Belting, Highflex and Cord Transmission Belting; Grommet V-Belts; Type 54 Air Hydraulic Control, Burst Proof Steam, Water, Suction and Other Hose; Armorite Chute Lining; Rubber and Koroseal Protective Clothing and Footwear; Tires and Tubes (Automobile, Truck, Off-the-Road, Industrial), Batteries

Goodyear Tire & Rubber Co., Inc.
Akron 16, Ohio
Airfoam; Mechanical Goods—Belting (Conveyor, Elevator, Transmission), Hose (Air Water, Steam, Suction, Miscellaneous), Chute Lining (Rubber); Rims (Truck and Tractor); Storage Batteries (Automobile, Truck, Tractor); Tires (Automobile, Truck, Off-the-Road); Tubes (Automobile, Truck, Off-the-Road, LifeGuard, Safety Tubes, Puncture Seal Tubes

Gruendler Crusher and Pulverizer Co.
2915 N. Market St., St. Louis 6, Mo.
Rock and Gravel Crushing and Screening Plants, Jaw Crushers, Roll Crushers, Hammermills, Lime Pulverizers

Gulf Oil Corp. Gulf Refining Co.
Gulf Bldg., Pittsburgh 19, Pa.
Lubricating Oils, Greases, Gasoline and Diesel Fuels

Haiss, George, Mfg. Co., Inc., Division Pettibone Mulliken Corp.
141st-144th on Park Ave., New York 51, N. Y.
Bucket Loaders, Buckets, Portable and Stationary Conveyors, Car Unloaders

Manufacturers Division—National Crushed Stone Association
(continued)

Harnischfeger Corp.
4400 W. National Ave., Milwaukee 14, Wis.
A complete line of Power Excavating Equipment, Overhead Cranes, Hoists, Smootharc Welders, Welding Rod, Motors and Generators, Diesel Engines

HarriSteel Products Co.
420 Lexington Ave., New York 17, N. Y.
Woven Wire Screen Cloth

Hayward Co.
50 Church Street, New York 7, N. Y.
Orange Peel Buckets, Clam Shell Buckets, Electric Motor Buckets, Automatic Take-up Reels

Heidenreich, E. Lee, Jr., Consulting Engineers
75 Second St., Newburgh, N. Y.
Plant Layout, Design, Supervision; Open Pit Quarry Surveys; Appraisals—Plant and Property

Hendrick Mfg. Co.
Carbondale, Pa.
Perforated Metal Screens, Perforated Plates for Vibrating, Shaking, and Revolving Screens; Elevator Buckets; Test Screens; Wedge Slot Screens; Open Steel Floor Grating

Hercules Powder Co.
Wilmington 99, Del.
Explosives and Blasting Supplies

Hetherington & Berner Inc.
701-745 Kentucky Ave., Indianapolis 7, Ind.
Asphalt Paving Machinery, Sand and Stone Dryers, Dust Collectors

Hewitt-Robins Incorporated
370 Lexington Ave., New York 17, N. Y.
Belt Conveyors (Belting and Machinery); Belt and Bucket Elevators; Car Shake-outs; Feeders; Industrial Hose; Screen Cloth; Sectional Conveyors; Skip Hoists; Stackers; Transmission Belting; Vibrating Conveyors, Feeders, and Screens; Design and Construction of Complete Plants

Illinois Powder Mfg. Co.
506 Olive St., St. Louis 1, Mo.
Gold Medal Explosives

Ingersoll-Rand Co.
11 Broadway, New York 4, N. Y.
Rock Drills, Quarrymaster Drills, Jackbits, Bit Reconditioning Equipment, Portable and Stationery Air Compressors, Air Hoists, Slusher Hoists, Air Tools, Diesel Engines, Pumps

Insley Manufacturing Corp.
801 N. Olney St., Indianapolis 6, Ind.
Concrete Carts and Buckets, ½ Yd. Cranes and Shovels

International Harvester Co.
180 N. Michigan Ave., Chicago 1, Ill.
Motor Trucks, Diesel and Gasoline Power Units; Crawler Tractors; Industrial Wheel Tractors

Iowa Manufacturing Co.
916 16th St., N.E., Cedar Rapids, Iowa
Rock and Gravel Crushing, Screening, Conveying and Washing Plants, Hot and Cold Mix Asphalt Plants, Stabilizer Plants, KU-BIT Impact Breakers, Screens, Elevators, Conveyors, Portable and Stationary Equipment, Hammermills

Jaeger Machine Co.
550 W. Spring St., Columbus 16, Ohio
Portable and Stationary Air Compressors, Self-Priming Pumps, Truck Mixers, Concrete Mixers, Road Paving Machinery, Hoists and Towers

Jaite Co.
Jaite, Ohio
Multiwall Paper Bags, Sewn and Pasted Style for Packaging Lime, Cement, Plaster, Etc.

Jeffrey Manufacturing Co.
E. First Ave., Columbus 16, Ohio
Material Handling Machinery, Crushers, Pulverizers, Screens, Chains

Johnson-March Corp.
1724 Chestnut St., Philadelphia 3, Pa.
Dust Allaying Equipment

Joy Manufacturing Co.
333 Henry W. Oliver Bldg., Pittsburgh 22, Pa.
Drills: Blast-Hole, Wagon, Rock, and Core; Air Compressors: Portable, Stationary, and Semi-Portable; Aftercoolers; Portable Blowers; Carpullers; Hoists; Multi-Purpose and Portable Rock Loaders; Air Motors; Trench Diggers; Belt Conveyors; Drill-Bit Furnaces; "Spaders"; "String-a-Lite" (Safety-Lighting-Cable); Backfill Tampers; Drill Bits: Rock and Core

Kennedy-Van Saun Mfg. & Eng. Corp.
2 Park Ave., New York 16, N. Y.
Crushing, Screening, Washing, Conveying, Elevating, Grinding, Complete Cement Plants, Complete Lime Plants, Complete Lightweight Aggregate Plants, Synchronous Motors, Air Activated Containers for Transportation of Pulverized Material, Cement Pumps, and Power Plant Equipment

Kensington Steel Co.
505 Kensington Ave., Chicago 28, Ill.
Manganese Steel Castings, Dipper Teeth, Crawler Treads, Jaw Plates, Concaves and Hammers

King Powder Co., Inc.
Cincinnati, Ohio
Detonite, Dynamites, and Blasting Supplies

Koehring Co.
3026 W. Concordia Ave., Milwaukee 16, Wis.
Excavating, Hauling and Concrete Equipment

Kraft Bag Corp.
630 Fifth Ave., New York 20, N. Y.
Heavy Duty Multiwall Paper Bags

Manufacturers Division—National Crushed Stone Association
(continued)

Le Roi Co.
Cleveland Rock Drill Division
12500 Berea Rd., Cleveland 11, Ohio
Air Compressors—Portable 60 Cfm. to 600 Cfm. Gas or Diesel; Tractairs—Combined Tractor with 105 Cfm. Air Compressor; Engines; Generator Sets; Rock and Wagon Drills; Jumbo Drill Rigs, Drifters, Stopers, Self Propelled Drill Rigs

Link-Belt Co.
300 West Pershing Road, Chicago 9, Ill.
Complete Stone Preparation Plants; Conveyors, Elevators, Screens, Washing Equipment, Speed-O-Matic Shovels—Cranes—Draglines and Power Transmission Equipment

Ludlow-Saylor Wire Co.
634 S. Newstead Ave., St. Louis 10, Mo.
Woven Wire Screens and Wire Cloth of Super-Loy, All Commercial Alloys and Metals

Mack Manufacturing Corp.
350 Fifth Ave., New York 1, N. Y.
On- and Off-Highway Trucks, Tractor Trailers, Six-Wheelers, from 5 to 30 Tons Capacity, both Gasoline- and Diesel-Powered

Marion Power Shovel Co.
617 W. Center St., Marion, Ohio
A Complete Line of Power Shovels, Draglines, and Cranes

Marsh, E. F., Engineering Co.
4324 W. Clayton Ave., St. Louis 10, Mo.
Plant Design, Engineering Service, Complete Pit and Quarry Equipment

McLanahan & Stone Corp.
200 Wall St., Hollidaysburg, Pa.
Complete Pit, Mine, and Quarry Equipment —Crushers, Washers, Screens, Feeders, etc.

Michigan Power Shovel Co.
270 Miller St., Benton Harbor, Mich.
Truck Mounted and Crawler Shovel Crane 3/8 and 1/2 Cu. Yd.

Murphy Diesel Co.
5317 W. Burnham St., Milwaukee 14, Wis.
Murphy Diesel Engines Ranging from 90 to 190 Continuous Horsepower at 1200 Rpm. and Packaged Type Generator Sets 60 to 133 Kw. for All Classes of Service

National Amalga-Pave, Inc.
357 S. Robertson Blvd., Beverly Hills, Calif.
Amalga-Pave Cold Mix Asphalt Paving Process

New York Rubber Corp.
100 Park Ave., New York 17, N. Y.
Conveyor Belting: Stonore, Dependable, and Cameo Grades; Transmission Belting: Silver Duck Duroflex, Soft Duck Rugged, Commercial Grade Tractor

Nordberg Mfg. Co.
3073 S. Chase Ave., Milwaukee 7, Wis.
Cone, Gyratory, Jaw and Impact Crushers; Grinding Mills; Stone Plant and Cement Mill Machinery; Vibrating Screens; Grizzlies; Diesel and Steam Engines; Compressors; Mine Hoists; Track Maintenance Tools

Northern Blower Co.
6409 Barberton Ave., Cleveland 2, Ohio
Dust Collecting Systems, Fans—Exhaust and Blower

Northwest Engineering Co.
135 S. LaSalle St., Chicago 3, Ill.
Shovels, Cranes, Draglines, Pullshovels

Olin Industries, Inc.
Explosives Division
East Alton, Ill.
Dynamite, Black Powder, Blasting Caps, Blasting Supplies

Osgood Co.
Cheney Ave., Marion, Ohio
Power Shovels, Cranes, Draglines, Hoes, Etc., 3/8 to 2 1/2 Cu. Yd.

Pennsylvania Crusher Co.
Liberty Trust Bldg., Broad and Arch Sts., Philadelphia 7, Pa.
Single Roll Crushers, Impactors, Hammermills, Ring Type Granulators, KUE-KEN Jaw Crushers, KUE-KEN Gyracones, Dixie Non-Clog and Standard Hammermills

Pettibone Mulliken Corp.
4710 W. Division St., Chicago 51, Ill.
Buckets, Dragline and Parts; Loaders—Car, Bucket; Plants—Asphalt, Portable

Pioneer Engineering Works, Inc.
1515 Central Ave., N. E., Minneapolis 13, Minn.
Jaw Crushers, Roll Crushers (Twin and Triple), Vibrating and Revolving Screens, Feeders (Mechanical, Grizzly, Apron, and Pioneer-Oro), Belt Conveyors, Portable and Stationary Crushing and Screening Plants, Washing Plants, Mining Equipment, Cement and Lime Equipment, Asphalt Plants

Pit and Quarry Publications
431 S. Dearborn St., Chicago 5, Ill.
Pit and Quarry, Pit and Quarry Handbook, Pit and Quarry Directory, Concrete Manufacturer, Concrete Industries Yearbook

Quaker Rubber Corp.
Tacony and Milnor Sts., Philadelphia 24, Pa.
Conveyor Belts, Hose, and Packings

Rock Bit Sales and Service Co.
350 Depot St., Asheville, N. C.
Tungsten Carbide Detachable Bits, "Rock Bit" Drill Steel Inlaid with Tungsten Carbide, Carbon Hollow Drill Steel, Alloy Hollow Drill Steel

Manufacturers Division—National Crushed Stone Association
(concluded)

Rock Products
309 West Jackson Blvd., Chicago 6, Ill.

Roebling's, John A., Sons Co.
Trenton 2, N. J.
Wire Rope, Fittings and Strand, Slings, Suspension Bridges and Cables, Aerial Wire Rope Systems, Ski Lifts, Electric Wire and Cable, Magnet Wire

Sanderson-Cyclone Drill Co.
South Main St., Orrville, Ohio
All Steel Wire Line, Air Speed Spudders, Large Blast Hole Drills, Drilling Tools and Drilling Supplies

Schield Bantam Co.
Waverly, Iowa
Bantam Trench Hoes, Draglines, Clams, Shovels

Screen Equipment Co.
1754 Walden Ave., Buffalo 25, N. Y.
SECO Vibrating Screens

Simplicity Engineering Co.
Durand, Mich.
Simplicity Gyrating Screen, Simplicity D'centegrator, Simplicity D'watering Wheel

SKF Industries, Inc.
Front St. and Erie Ave., P. O. Box 6731, Philadelphia 32, Pa.
Anti-Friction Bearings—Self-Aligning Ball, Single Row Deep Groove Ball, Angular Contact Ball, Double Row Deep Groove Ball, Spherical Roller, Cylindrical Roller, Ball Thrust, Spherical Roller Thrust; Pillow Block and Flanged Housings—Ball and Roller

Smith Engineering Works
532 E. Capitol Drive, Milwaukee 12, Wis.
Gyratory, Gyrasphere, Jaw and Roll Crushers, Vibrating and Rotary Screens, Gravel Washing and Sand Settling Equipment, Elevators and Conveyors, Feeders, Bin Gates, and Portable Crushing and Screening Plants

Stedman Foundry & Machine Co., Inc.
Aurora, Ind.
Stedman Impact-Type Selective Reduction Crushers, 2-Stage Swing Hammer Limestone Pulverizers

Stephens-Adamson Mfg. Co.
Aurora, Ill.
Belt Conveyors, Elevators, Feeders, Car Pullers, Screens, Skip Hoists, Complete Plants

Talcott, W. O. & M. W., Inc.
91 Sabin St., Providence 1, R. I.
Belt Fasteners, Belt Lacing, Conveyor Belt Fasteners, and Patch Fasteners

Taylor-Wharton Iron & Steel Co.
High Bridge, N. J.
Manganese and other Special Alloy Steel Castings; Dipper Teeth, Fronts and Lips; Crawler Treads; Jaw and Cheek Plates; Mantles and Concaves; Pulverizer Hammers and Liners; Asphalt Mixer Liners and Tips; Manganese Nickel Steel Welding Rod and Plate

Thew Shovel Co.
East 28th St. and Fulton Rd., Lorain, Ohio
Power Shovels, Cranes, Crawler Cranes, Locomotive Cranes, Draglines, Diesel Electric, Gasoline, 3/8 to 2 1/2 Cu. Yd. Capacities

Torrington Co.
Bantam Bearings Division
3702 W. Sample St., South Bend 21, Ind.
Anti-Friction Bearings; Roller Bearings: Spherical, Tapered, Straight, Ball, Needle

Traylor Engineering & Mfg. Co.
Allentown, Pa.
Stone Crushing, Gravel, Lime, and Cement Machinery

Trojan Powder Co.
17 N. 7th St., Allentown, Pa.
Explosives and Blasting Supplies

Tyler, W. S., Co.
3615 Superior Ave., N. E., Cleveland 14, Ohio
Woven Wire Screens; Ty-Rock, Tyler-Niagara and Ty-Rocket (Mechanically Vibrated) Screens; Hum-mer Electric Screens; Ro-Tap Testing Sieve Shakers and Tyler Standard Screen Scale Sieves

Universal Engineering Corp.
625 C Ave., N. W., Cedar Rapids, Iowa.
Jaw Crushers, Roll Crushers, Hammermills, Complete Crushing, Screening, and Loading Plants, Either Stationary or Portable for Stone Aggregates or Aglime

Vibration Measurement Engineers
7665 Sheridan Rd., Chicago 26, Ill.
Specialists in Blasting Complaint Investigations; Seismological Surveying; Expert Testimony in Blasting Litigation

Werco Steel Co.
2151 E. 83rd St., Chicago 17, Ill.
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White Motor Co.
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